

***Mariania deyderi* (COTTEAU, 1897)**

(Fig. 91; Pl. 80, Figs. 1a-e)

- non 1896 *Spatangus deyderi*, COTTEAU – DOUXAMI: 256-257; pl. 1, figs. 12
- \* 1897 *Spatangus Deydieri*, COTTEAU, 1894. – COTTEAU: 185-187; pl. 10, figs. 2-4; pl. 11, figs 1-6 [figs. 3-6 on pl. 11 are erroneously designated *Spatangus rissoi* on the plate caption; fide PHILIPPE (1998: 216); according to LAMBERT (1915a: 205) the specimens reported as var. *major* from the Tortonian of Cucuron are *S. delphinus*]
- non 1907 *Spatangus Deydieri* COTTEAU (*Spatangus*), 1894 – SAVIN: 11-12 [fide PHILIPPE (1998: 216)]
- 1913a *S.[patangus] Deydieri* COTT. – COTTREAU: 76
- 1915a *Mariania Deydieri* COTTEAU (*Spatangus*), 1896. – LAMBERT: 205-206
- ? 1915a *Mariania Deydieri* COTTEAU (*Spatangus*) – LAMBERT: pl. 15, fig. 10 [in the text (p. 204) this figure is referred to *M. marmorae*; PHILIPPE (1998: 216) list it under *M. deyderi*]
- 1973 *Mariania deyderi* (COTTEAU, 1896) – PHILIPPE: 195-196; text-fig. 31c
- 1989 *Mariania deyderi* (COTTEAU) – PHILIPPE: 32, tab. 1
- 1998 *Spatangus (Mariania) deyderi* COTTEAU, 1896 – PHILIPPE: 216-219; pl. 25, figs. 4-6

**Type-material:**

*Spatangus deyderi* COTTEAU, 1897:

Syntypes: 2 syntypes described and figured in COTTEAU (1897: 21-23; pl. 10, figs. 1-6; figures 3-6 erroneously indicated as *Spatangus rissoi* in the legend of the plate); no. MR 3 000 211 (casts); Muséum Requien, Avignon, France (PHILIPPE, 1998: 332)

Locus typicus: Reillanne, Alpes-de-Haute-Provence, France

Age: Burdigalian, Early Miocene

**Material:**

Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), near Maissau, NÖ, Austria

NHMW: 1 specimen (NHMW 1998z0048/0102)

**Dimensions (in mm):**

Inv. No.	TL	TW	TH
NHMW 1998z0048/0102	35.3	36.2	> 9.6

**Description:**

**Size and shape:** Test small, broadly heart-shaped with transversely truncated posterior margin and broad but shallow frontal sinus. The maximum width lies at the level of interambulacral columns 1b and 4a. In profile the test is low with a low, obliquely truncated posterior end. The maximum height lies around the apical disc. Oral side flat with slightly inflated plastron. Test width 102.5 % of TL, test height at least 28 % TL, probably up to 34 % (considering the post-mortem deformation).

**Apical disc:** Not preserved in the studied specimen. It lies slightly anterior of the centre, about 45-47 % from the anterior margin.

**Ambulacra:** Adapically the paired ambulacra are petaloid. The petals are relatively broad, only slightly closing distally and subequal in length, extending about three third of the corresponding test radius. The anterior paired petals form an obtuse angle of about 125°, the posterior paired petals an acute angle of about 60°. The pores within the petals are elongate isopores. Outside the petals only minute unipores are found (except in the phylloides). The pores of the uppermost seven to eight plates in the anterior plate rows of ambulacra II and IV are minute partitioned isopores. The interporiferous zones are up to one and a half times as wide as a single poriferous zone and bear only secondary and miliary tubercles. Four to five

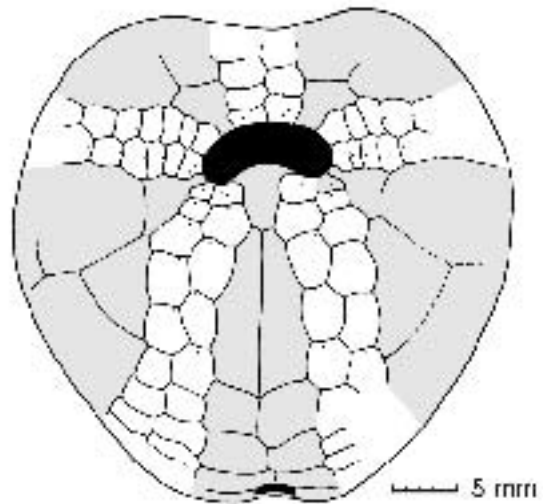


Figure 91: *Mariania deyderi* (COTTEAU, 1897): oral plating (Grübern, near Maissau, NÖ, NHMW 1998z0048/0102). Drawn from the inner surface of the test which was exposed during preparation (mirrored for easier comparison with the other drawing which were made from the outer surface); interambulacra shaded.

ambulacral plates border each interambulacral plate in the distal part of the petals.

Ambulacrum III is nonpetaloid and slightly depressed, forming a broad shallow frontal notch. The pores are oblique, minute partitioned iso(?)pores. Only secondary and miliary tubercles are found in ambulacrum III.

On the oral side ambulacra I and V form broad peri-plastral areas, which bear only miliary and/or small secondary tubercles. The phylloides are well developed and bear relatively many large unipores with extensive periporal area. In ambulacrum III seven such pores are present, fourteen in each of the anterior paired ambulacra and eight in the posterior paired ambulacra.

**Interambulacra:** Aborally the interambulacra are inflated between the petals. They are densely covered by closely spaced miliary and secondary tubercles. Primary tubercles are found in all interambulacra, near the apex as well as near the margin. The largest primary tubercles are located along the interradian sutures in interambulacra 1, 4 and 5. In the interambulacra 2 and 3 the largest tubercles are situated along the adradial sutures with the anterior paired petals. The tubercles are crenulate and perforate.

Orally interambulacrum 5 forms a narrow, holamphisternous plastron (Fig. 91). The labrum is elongated and projects into the peristome. The sternum is about 0.5 times wide as long (12.4 mm long, 6.6 mm wide in the studied specimen). The episternal plates are not markedly indented by the interambulacra. The tuberculation on the oral side consists of closely spaced primary tubercles, increasing in size from the margin towards the peristome. On the plastron the primary tubercles form a fan-shaped pattern radiating from a posterior elevation on the sternum and a central elevation on each episternal plate. The labrum, in contrast, bears only few tubercles located around its centre.

**Peristome:** The peristome is situated anteriorly, about 25 % TL from the anterior margin. It is transversely elongated, kidney-shaped and measures 8.3 mm vs. 4.0 mm in the studied specimen.

**Periproct:** The periproct lies on the overhanging posterior end of the test. It seems to have been oval, transversely elongated and about 4 mm wide, but is poorly preserved because the test is crushed.

**Fascioles:** No fascioles discernible.

### Differential diagnosis:

This species differs from *M. marmorae* (DESOR in AGASSIZ & DESOR, 1847) mainly by its lower test. In that species test height is typically > 50% TL, whereas in *M. deydierei* it is usually between 30 to 36 % TL (based on the available description of the two species).

This species differs from *Spatangus austriacus* and related species by its different distribution of primary tubercles aborally (which are scattered over the whole aboral surface, instead of being restricted to the adapical part), the absence of a subanal fasciole, its long petals and narrow plastron.

### Discussion:

Only a single specimen from marly calcarenites of Grübern was available of this taxon. It is highly similar to the material described as *Spatangus (Mariania) deydierei* by PHILIPPE (1998). Although the test of the sole specimen is well preserved and its underside has been carefully exposed by gently air-abrasive techniques, no traces of a subanal fasciole could be found. Instead, judging by the pattern of the tuberculation in comparison with specimens of other spatangids of similar size, no fasciole seems to have been present.

There are some uncertainties about the publication date of this species. While PHILIPPE (1998: 216) gives the year 1896, the front-page of the volume in which COTTEAU's paper was published states 1897 as publication date. Unfortunately the situation is complicated by the paper of DOUXAMI (1896), who cites the then unpublished (?) paper of COTTEAU and provides a description and illustrations of a *Spatangus deydierei* COTTEAU, 1896 (based on the manuscript of COTTEAU's paper which was sent to him by DEPÉRET). Unfortunately, DOUXAMI's paper seems to have been published before COTTEAU's and, even more regrettable, DOUXAMI's specimen is not conspecific with COTTEAU's but represents probably *S. delphinus* according to PHILIPPE (1998: 218). The present author was not able to verify the publication dates of the two papers in question. In case DOUXAMI's paper was really the first to be published either a new name for COTTEAU's species is needed or the species of DOUXAMI has to be suppressed by action of the ICZN.

### Occurrence:

**Austria:** Late Eggenburgian (Early Burdigalian)

Molasse Zone: Grübern (Zogelsdorf Fm.), near Maissau, NÖ ([NHMW])

**Mediterranean:** Burdigalian

Rhône Basin: Apt (PHILIPPE, 1998); Couronne (PHILIPPE, 1973); Forcalquier (PHILIPPE, 1998); Lincel (PHILIPPE, 1998); Mane (PHILIPPE, 1998); Niozelles (PHILIPPE, 1998); Pierrerrue (PHILIPPE, 1998); Reillanne (COTTEAU, 1897; LAMBERT, 1915a; PHILIPPE, 1973, 1998); Saint-Martin-de-Castillon (PHILIPPE, 1998); Saint-Michel-l'Observatoire (PHILIPPE, 1998); Viens (PHILIPPE, 1998); Villemus (PHILIPPE, 1998)

Family Loveniidae LAMBERT, 1905

Genus *Lovenia* DESOR in AGASSIZ & DESOR, 1847

**Type-species:** *Lovenia hystrix* DESOR in AGASSIZ & DESOR, 1847; by monotypy (DESOR in AGASSIZ & DESOR, 1847b: 10-11); today considered as junior synonym of *Lovenia elongata* (GRAY, 1845) (see DOLLFUSS & ROMAN, 1981: 110).

**Diagnosis:** Test elongate, cordate with distinct frontal notch; low profile; apical disc ethmolytic with four gonopores; ambulacrum III nonpetaloid with minute pores; other ambulacra petaloid, widening towards the apex, in most species ambulacral columns Ib and IIa, respectively IVb and Va form a continuous arc; pores are elongate isopores, except inside the internal fasciole, where they are minute or altogether absent; peristome anteriorly displaced and transversely elongated; periproct on low posterior face, sunken in some species; plastron ultramphisternous; labral plate long, with narrow contact to sternal plates; sternal plates tuberculated only on the posterior third; aboral tuberculation heterogeneous with large tubercles sunken in camellae (except in interambulacrum 5); oral tubercles prominent laterally and arranged in distinct rows, areoles deeply sunken with and parapet typically helically spiralled; well developed internal and subanal fascioles; subanal fasciole bilobed (modified from MORTENSEN, 1951, and SMITH "The Echinoid Directory", 28.07.2003).

**Distribution:** Oligocene to Recent (HENDERSON, 1975) – cosmopolitan, except polar and sub-polar regions

### *Lovenia mortenseni* ČTYROKÝ, 1965

(Fig. 92)

- 1957 *Hemipatagus* sp. – ČTYROKÝ: 237, tab. 3, 4
- \* 1965 *Lovenia mortenseni* n. sp. – ČTYROKÝ: 108-118; text-figs. 1-6; pl. 1, figs. 1-4; pl. 2; pl. 3; pl. 4, figs. 1-4; pl. 5, figs. 1-3; pl. 6, figs. 1-4
- 1967 *Lovenia mortenseni* ČTYROKÝ. – ČIČHA et al.: 87
- 1975 *Lovenia mortenseni* (ČTYROKÝ, 1957) – KALABIS: 176
- 1978 *L. [lovenia] mortenseni* ČTYROKÝ, 1965 – KIER & LAWSON, 121
- v. 2003b *Lovenia mortenseni* ČTYROKÝ, 1965 – KROH: 252; pl. 1, fig. 3

### Type-material:

*Lovenia mortenseni* ČTYROKÝ, 1965:

Holotype: ÚÚG-PČ 15D2 (figured by ČTYROKÝ, 1965: pl. 1, figs. 1-2); Geological Survey, Praha, Czech Republic

Paratypes: ÚÚG-PČ 22D0, 79D4 and 34D0; Geological Survey, Praha, Czech Republic

Locus typicus: Dubovce near Hodonín, Slovak Republic

Stratum typicum: Lower member of the Carpathian Fm.

Age: Karpatian (Late Burdigalian), late Early Miocene

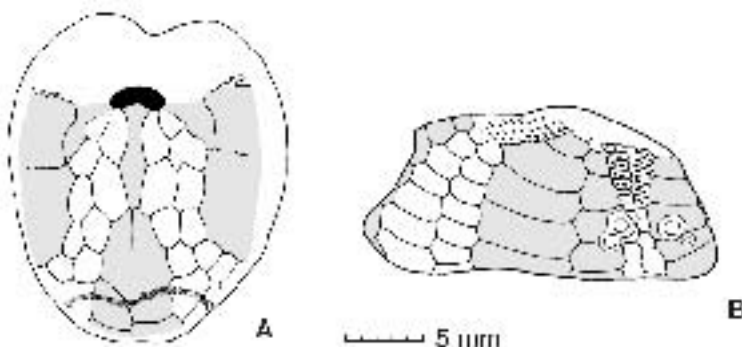


Figure 92: *Lovenia mortenseni* ČTYROKÝ, 1965: oral plating (A) and lateral view (B) (A: paratype, ÚÚG PČ-22D0; B: paratype, ÚÚG PČ-79D4 both from Dubovce, c. 7 km ESE Holíč, Slovak Republic). Interambulacra shaded.

**Material:**

Karpatian (Late Burdigalian) – Oreske, c. 14 km ESE Holíč, Slovak Republic

NHMW: 1 specimen (NHMW 2002z0165/0001)

Karpatian (Late Burdigalian) – Strachotín, c. 11 km N Mikulov, southern Moravia, Czech Republic

Univ. Brno: numerous specimens (no inv. nos.; see POSPÍCHA-LOVÁ in KROH, 2003b)

**Dimensions (in mm):**

Inv. No.	TL	TW	TH	remarks
ÚÚG-PČ 15D2	22.0	21.5	-	holotype
ÚÚG-PČ 22D0	22.0	17.0	-	paratype
ÚÚG-PČ 79D4	23.5	-	11.1	paratype
NHMW	>15.4	>15.7	-	

Due to the fact that all known specimens are mostly deformed internal moulds or natural casts, the measurements may be inaccurate.

**Description:**

**Size and shape:** Test small, up to 25 mm in test length with heart-shaped outline. Frontal notch wide and relatively deep. In profile the test is moderately arched, with an obliquely truncated posterior end (Fig. 92.B). The maximum height lies more or less centrally, posterior of the apical disc.

**Apical disc:** The apical disc is ethmolytic with 4 circular gonopores. It lies anterior of the centre, between 35 and 45 % TL from the anterior margin

**Ambulacra:** Aborally the paired ambulacra are petaloid and slightly depressed adapically. The petals are subequal in size and extend about two third of the corresponding test radius. In larger specimens the posterior petals are slightly longer. Inside the internal fasciole no ambulacral pores are discernible. Outside the internal fasciole the ambulacral pore pairs are conjugate, elongate isopores. The anterior paired petals form an obtuse angle of about 125°, the posterior paired petals an acute angle of about 50 to 60°. The posterior paired petals are sharply flexed backwards and contain eight to twelve pores in each poriferous zone. The tips of the anterior paired petals are flexed laterally. In the posterior poriferous zone of the anterior paired petals there are usually between seven and nine pore pairs, the anterior plate row bears between five and six. The interporiferous zones are small, being only about two third as wide as a single poriferous zone.

The frontal ambulacrum is nonpetaloid and flush with the interambulacra adapically. Towards the ambitus it becomes increasingly depressed. In ambulacrum III only very small, oblique, partitioned isopores are present.

**Interambulacra:** The interambulacra 1, 2, 3, and 4 are characterised by the presence of large camellate primary tubercles with well developed internal ampullae. In the interambulacra 1 and 4 their number ranges from 1 to 4, most specimens have 2, whereas in the interambulacra 2 and 3 their number ranges from 1 to 5 and most specimens have 3. These tubercles are crowded at the distal part of the anterior paired petals, but their exact position and number is quite variable. During ontogeny the number of primary tubercles increases. The remaining aboral surface is rather densely covered by secondary and miliary tubercles.

On the oral side interambulacra 1 to 4 are densely covered with camellate primary tubercles, which increase in size from the margin of the test towards the centre. Interambulacrum 5 lacks such primary tubercles and totally lacks tubercles on the labrum and anterior half of the sternum. The plastron is ultramphistermous with a narrow contact between labrum and sternum (Fig. 92.A). The labrum is long and slender, slightly projecting over the peristome. Posteriorly interambulacrum 5 forms a well pronounced subanal heel.

**Peristome:** The peristome lies anteriorly, about 25 % TL from the anterior margin. It is kidney-shaped and transversely elongated.

**Periproct:** The periproct is partly obscured in all available specimens. It lies high on the oblique posterior end of the test in a depression.

**Fascioles:** Both an internal and subanal fasciole are present. The fasciole bands are moderately broad and well distinguished from the remaining tuberculation (orthofasciole *sensu* NÉRAUDEAU et al., 1998b). The internal fasciole crosses the suture of interambulacrum 5 well behind the apical disc. The subanal fasciole is bilobed and consists of a rather broad fasciole band.

**Differential diagnosis:**

A superficially similar species is *Lovenia anteroalta* (GREGORY, 1891) from the Burdigalian to Langhian of the Maltese Islands and the Burdigalian of the Rhône Basin [considered to be a junior synonym of *L. duncani* (GREGORY, 1891) by CHALLIS (1980), but rejected by PHILIPPE (1998: 223-225)]. According to ČTYROKÝ (1965: 115) *L. anteroalta* differs from this species by its larger test, greater number of pore pairs in the anterior paired petals and the shape of the internal fasciole. Comparison with *L. anteroalta* specimens from Gozo housed at the Naturhistorisches Museum Wien (Geologische Abteilung) revealed that the distinct subanal heel which characterises *L. mortenseni* is not present in *L. anteroalta*.

Most other species of *Lovenia* are well distinguished from *L. mortenseni*, an extensive discussion on this can be found in ČTYROKÝ (1965: 115-117).

**Discussion:**

Although not yet recovered from Austrian deposits, it is highly likely that this species is also present in contemporaneous deposits in Austria.

The plating patterns illustrated by ČTYROKÝ (1965: figs. 1, 5, and 6) are erroneous. Corrected drawings are provided here (Figs. 92.A-B).

**Occurrence:**

**Paratethys (non-Austrian occurrences):** Karpatian (Late Burdigalian)

Vienna Basin: Dubovce, c. 7 km ESE Holíč, Slovak Republic (ČTYROKÝ, 1965; KALABIS, 1975; CÍCHA et al., 1967; KROH, 2003b); Oreske, c. 14 km ESE Holíč, Slovak Republic (ČTYROKÝ, 1965, KALABIS, 1975; KROH, 2003b); Radošovce, c. 9 km ESE Holíč, Slovak Republic (CÍCHA et al., 1967); Strachotín, c. 11 km N Mikulov, Czech Republic (POSPÍCHA-LOVÁ in KROH, 2003b)

Genus *Echinocardium* GRAY, 1825

**Type-species:** *Echinus cordatus* PENNANT, 1777; by subsequent designation (ICZN, opinion 209, p. 385, 8<sup>th</sup> May 1954)

**Diagnosis:** Test ovate to cordate, with or without frontal notch; apical disc ethmolytic with four gonopores; ambulacrum III nonpetaloid, sunken or flush with the test; paired ambulacra petaloid; petals widening towards the apex; rudimentary pores within the internal fasciole, elongate isopores outside; pore zones Ib and IIa, respectively IVb and Va may form continuous lateral arcs; peristome anteriorly displaced, kidney-shaped; periproct on vertically truncated posterior end; labrum short but wide; sternal plates large and fully tuberculate; tuberculation homogenous, except in interambulacral columns 2b and 3a where larger tubercles are developed at the border to ambulacrum III; tubercles never sunken; well developed internal and subanal fascioles; anal branches reaching upwards from the subanal fasciole may be developed (modified from MORTENSEN, 1951 and SMITH "The Echinoid Directory", 28.07.2003).

**Distribution:** Early Miocene to Recent – cosmopolitan, except polar and sub-polar regions

**Ecology and biogeography:** Extant species inhabit a wide range

of environments ranging from the intertidal to the mid-shelf and from muddy sand to shell gravel.

***Echinocardium depressum***  
(AGASSIZ in AGASSIZ & DESOR, 1847)

(Fig. 93; Pl. 80, Figs. 2a-d)

- \* 1847b [*Amphidetus depressus* AGASS. – AGASSIZ in AGASSIZ & DESOR: 12
- 1852 [*Amphidetus depressus*, AGASS. – D'ORBIGNY: 139; No. 2623
- 1858 [*Echinocardium depressum* Syn. *Amphidetus depressus* AGASS. – DESOR: 407
- # 1885 *Echinocardium tuberculatum* GAUTHIER, 1885. – GAUTHIER in COTTEAU: 61-63; pl. 8, figs. 11-14
- 1885 *Echinocardium depressum* AGASSIZ, 1840. – COTTEAU: 64
- 1892 *Echinocardium depressum*, AG. – DEPÉRET in FONTANNES: 42
- ? 1892 *Amphidetus depressus* – GOURRET: 130
- 1913a *E.[chinocardium] depressum* AG. (*Amphidetus*) – COTTREAU: 78
- 1915a *Amphidetus depressus* AGASSIZ, 1847. – LAMBERT: 208-209; pl. 16, figs. 4-7
- 1915a *Amphidetus tuberculatus* GAUTHIER (*Echinocardium*, in COTTEAU), 1885. – LAMBERT: 209; pl. 15, fig. 11
- # 1915a *Amphidetus granifer* LAMBERT. – LAMBERT: 210; pl. 16, figs. 1-3
- 1920 *Echinocardium depressum*, AGASSIZ 1847. – FOURTAU: 91-92; pl. 7, fig. 3
- 1926 *Amphidetus depressus* AGASSIZ – LAMBERT: 252-253
- 1926 *Amphidetus tuberculatus* (GAUTHIER) (*Echinocardium*) – LAMBERT: 253
- 1973 *Echinocardium tuberculatum* GAUTHIER, 1885 – PHILIPPE: 199-200
- 1984 *Echinocardium depressum* (AGASSIZ), 1847 – NEGRETTI: 124-125; pl. 10, fig. 7
- 1984 *Echinocardium tuberculatum* GAUTHIER in COTTEAU, 1885 – NEGRETTI: 125-126; pl. 10, figs. 8-15
- 1989 *Echinocardium depressum* (AGASSIZ) – PHILIPPE: 32; tab. 1
- 1990 *Echinocardium depressum* (AGASSIZ, 1847) – PHILIPPE et al.: 247
- 1998 *Echinocardium depressum* (AGASSIZ, 1847) – PHILIPPE: 225-229; pl. 26, figs. 2-6
- ? 2001 *Echinocardium depressum* (L. AGASSIZ, 1847) – RADWAŃSKI & WYSOCKA: 307

**Type-material:**

*Amphidetus depressus* AGASSIZ in AGASSIZ & DESOR, 1847:

Locus typicus: Cap Couronne, near Martigues, Bouches-du-Rhône, France

Age: Burdigalian, Early Miocene

Remarks: the whereabouts of the type-material, originally in the collection of MICHELIN, is unknown

*Echinocardium tuberculatum* GAUTHIER in COTTEAU, 1885:

Holotype: the specimen figured by COTTEAU (1885: pl. 8, figs. 11-14); a cast is housed in the collection LAMBERT, Muséum national, Paris (PHILIPPE, 1998: 335)

Locus typicus: Cap Couronne, near Martigues, Bouches-du-Rhône, France

Age: Burdigalian, Early Miocene

*Amphidetus granifer* LAMBERT, 1915:

Holotype: the specimen figured by LAMBERT (1915a: pl. 16, figs. 1-3); a cast is housed in the collection LAMBERT, Muséum national, Paris (PHILIPPE, 1998: 335)

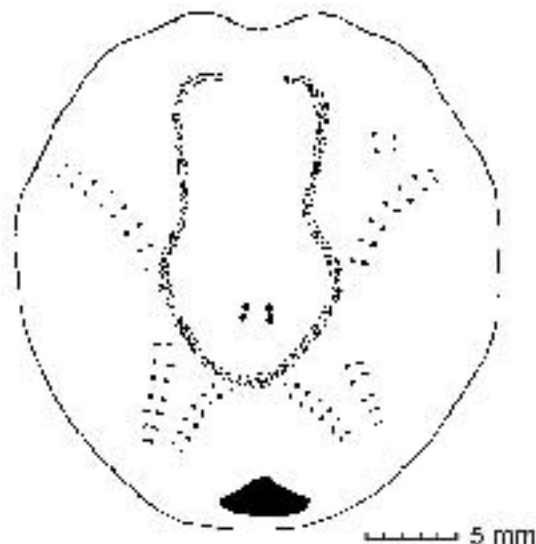


Figure 93: *Echinocardium depressum* (AGASSIZ in AGASSIZ & DESOR, 1847b): shape of the internal fasciole and the petals (Florianibründl, near Eggenburg, NÖ, Austria, NHMW 2002z0171/0001).

Locus typicus: Cap Couronne, near Martigues, Bouches-du-Rhône, France

Age: Burdigalian, Early Miocene

**Material:**

Late Eggenburgian (Early Burdigalian) – Eggenburg (Florianibründl), NÖ, Austria

NHMW: 1 specimen (NHMW 2002z0171/0001)

**Dimensions (in mm):**

Inv. No.	TL	TW	TH
NHMW 2002z0171/0001	28.0	27.3	14.2

**Description:**

**Size and shape:** Test of medium size, with subcircular to slightly oval outline and shallow frontal sinus. In profile the test is slightly wedge shaped. Anterior end tumid, posterior end obliquely truncated. The maximum width lies about halfway along the length, the maximum height posteriorly along the rounded keel in interambulacrum 5.

**Apical disc:** The apical disc lies posterior of the centre, about 55 % TL from the anterior margin. It is ethmolytic and has four circular gonopores.

**Ambulacra:** The ambulacra are slightly depressed on aboral side between the apical disc and the ambitus. The paired ambulacra are greatly widened adapically and moderately depressed. The frontal ambulacrum, in contrast, is narrow and more depressed. Inside the internal fasciole no pores are found in the paired ambulacra. Outside of it the ambulacral pores are elongated isopores. Outside the petals only minute unipores are present (except in the phyllodes). Ambulacrum III is depressed between the peristome and the anterior margin.

**Interambulacra:** The interambulacra are slightly inflated between the petals. They are covered by small perforate, crenulate tubercles. The plastron is ultramphisterous (?), and the posterior end of the plastron forms a pointed projection.

**Peristome:** The peristome lies anterior on the oral side, about 30 % TL from the anterior margin. It is kidney shaped and relatively large, 6.0 mm wide in the studied specimen. The labrum is broad and projects slightly into the peristome.

**Periproct:** The periproct lies high on the vertical posterior end of the test in interambulacrum 5. It is oval (transversely elongated) to slightly teardrop-shaped. Its adoral margin is round-

ed, the adapical margin pointed. It is distinctly smaller than the peristome, measuring 4.7 mm in width.

**Fascioles:** The internal fasciole is well developed and belongs to the orthofasciole type of NÉRAUDEAU et al. (1998b). The shape of the internal fasciole can be seen in Fig. 93, note the distinct widening as the fasciole passes laterally of the apical disc. The subanal fasciole lies on the lowermost part of the vertical posterior end and has a subcircular to oval outline.

#### Differential diagnosis:

The Middle Miocene species *E. leopolitanum* RADWAŃSKI & WYSOCKA, 2001 from the Ukraine differs from this species by its higher, box-shaped profile, less wide petals and different shape of the internal fasciole.

*E. peroni* COTTEAU, 1877 from the Burdigalian of the Rhône Basin and the Middle Miocene of Corsica differs by its much narrower petals, well developed subanal keel and smaller internal fasciole (for a description of *E. peroni* see PHILIPPE, 1998).

*E. intermedium* LÓCZY, 1877 from the Middle Miocene of Hungary, which is very similar to *E. peroni* and probably synonymous to it, has much smaller petals, a higher profile, an antero-posteriorly elongated outline and a pronounced subanal heel or rostrum (compare LÓCZY, 1877, and VADÁSZ, 1915).

*E. biaense* MIHÁLY, 1985 from the Middle Miocene of Hungary is synonymous to *E. peroni* according to RADWAŃSKI & WYSOCKA (2001: 307).

*E. deikeyi* DESOR, 1858 from the Burdigalian of Switzerland differs by its more elongate shape and broader ambulacrum III (see DESOR, 1858; DE LORIOU, 1875; PHILIPPE, 1998). The types and other material from the Swiss Molasse are, however, poorly preserved and deformed and comparison is difficult. Material from the Middle Miocene of Poland reported by MAĆZYSKA (1979) was reassigned to *E. peroni* by PHILIPPE (1998: 231).

#### Discussion:

The sole specimen fits best with the contemporary *E. depressum* from the Burdigalian of the Rhône Basin. PHILIPPE (1998: 225-229) synonymised *E. tuberculatum* GAUTHIER in COTTEAU, 1885 and *E. granifer* (LAMBERT, 1915a) with *E. depressum*.

This is the first record of this species from the Neogene of Austria. Apart from the present record *Echinocardium* is known only from three other localities in Austria (see below under *Echinocardium* sp.), two of which are new. The third (TOLLMANN, 1955: tab. 1) could not be confirmed and probably refers to disarticulated spatangoid material. Five other species of the genus *Echinocardium* have been recorded from the Paratethys [all but one of them from Badenian (Langhian to Early Serravallian) strata]. They are briefly discussed in the section dealing with Paratethyal species not recorded from Austria until now (see below). Considering the morphological plasticity of and the difficulties in classifying the extant *Echinocardium cordatum/fenauxi*-complex (see DAVID & LAURIN, 1996; DAVID et al., 1999; CHENULI & FÉRAL, 2003 and references therein) casts some doubts on these four fossil species. They need to be re-examined on base on well preserved material to establish whether they are separate species or not (most are based on few poorly preserved specimens).

#### Occurrence:

**Austria:** Late Eggenburgian (Early Burdigalian)  
Molasse Zone: Eggenburg (Florianibründl), NÖ  
([NHMW])

**Paratethys (non-Austrian occurrences):** Obere Meeresmolasse (Middle Burdigalian); ? Early Badenian (Langhian)

Swiss Molasse: La Chaux-de-Fonds (LAMBERT, 1926)  
Fore-Carpathian Basin: ? Huta Lubycka, Poland (RADWAŃSKI & WYSOCKA, 2001)

#### Mediterranean: Burdigalian

Western Mediterranean: S<sup>te</sup> Colombe, near Vence, Alpes Maritimes, France (LAMBERT, 1915a); Vence, Alpes Maritimes, France (COTTEAU, 1913a)

Rhône Basin: Apt (PHILIPPE, 1998); Auribeau (PHILIPPE, 1998); les Beaumettes (PHILIPPE, 1998); Bonnieux (PHILIPPE, 1998); Buoux (PHILIPPE, 1998); Cap Couronne près Martigues, Bouches-du-Rhône (AGASSIZ & DESOR, 1847b; D'ORBIGNY, 1852; DESOR, 1858; COTTEAU, 1885; DEPÉRET in FONTANNES, 1892; COTTEAU, 1913a; LAMBERT, 1915a; PHILIPPE, 1972; NEGRETTI, 1984; PHILIPPE et al., 1990); Carry (LAMBERT, 1915a); Grignan (PHILIPPE, 1998); Istres (PHILIPPE, 1998); Lacoste (PHILIPPE, 1998); Martigues, Nerthe (PHILIPPE, 1998); Pierrerue (PHILIPPE, 1998); Plan d'Arren, Bouches-du-Rhône (LAMBERT, 1915a); E of Port de Tamaris to Anse du Verdon, Nerthe (NEGRETTI, 1984; PHILIPPE et al., 1990); Saint-Mitre-les-Remparts (PHILIPPE, 1998); St-Martin-de-Castillon (PHILIPPE, 1998); St Michel-l'Observatoire (PHILIPPE, 1998); Eastern (PHILIPPE, 1998)

Egypt: Eastern Mediterranean: Gebel Tanka, Sinai, Egypt (FOURTAU, 1920)

#### *Echinocardium* sp.

(Pl. 80, Figs. 3a-c)

? 1955 *Echinocardium* sp. – TOLLMANN: tab. 1

? 1981 *Echinocardium* sp. – HALMAI: 106

#### Material:

Early Eggenburgian (Early Burdigalian) – Gösing (Fels Fm.), NÖ, Austria

KM: 7 specimens and 2 fragments (no inv. nos.)

Badenian (Langhian-Early Serravallian) – Oslip (sandpit E of the village), Bgld, Austria

FÜRNKRANZ coll.: 1 fragmentary specimen (no inv. no.)

#### Dimensions (in mm):

Inv. No.	TL	TW	TH
KM spec. 1	17.6	17.2	10.1
KM spec. 2	19.1	17.4	12.1
KM spec. 3	21.4	18.1	14.3
KM spec. 4	24.1	22.9	14.3
KM spec. 5	24.1	24.0	12.6
KM spec. 6	25.5	24.5	14.4
KM spec. 7	43.5	43.3	21.8

#### Discussion:

Albeit clearly belonging to the genus *Echinocardium* the material is too fragmentary (Oslip specimen), respectively too poorly preserved (covered by syntaxial cement, sand and still-attached spines in case of the Gösing specimens) to allow specific determination.

The record of TOLLMANN (1955) is based on disarticulated spines and plates. It cannot be judged with certainty whether that material was correctly attributed to *Echinocardium* or refers to indeterminate spatangoid debris. None of the mentioned localities of TOLLMANN yielded material confidently attributable to *Echinocardium* despite extensive sampling (both by scientists and private collectors) since TOLLMANN's publication. Halmai's (1981) record is based on an unpublished Ph.D. thesis and could not be verified

#### Occurrence:

**Austria:** Early Eggenburgian (Early Burdigalian), Badenian (Langhian-Early Serravallian)

Molasse Zone: Gösing (Fels Fm.), NÖ ([KM])

Eisenstadt-Sopron Basin: ? Großhöflein, near Eisenstadt, Bgld (TOLLMANN, 1955); ? Hartl, Eisenstadt, Bgld (TOLLMANN, 1955); ? Müllendorf, Bgld (TOLLMANN, 1955); Oslip, Bgld ([FÜRNKRANZ coll.])

Paratethys (non-Austrian occurrences): ? Karpatian (Late Burdigalian)

Great Hungarian Basin (Pannonian Basin): Kisalag, Hungary (HALMAI, 1981)

Genus *Hemipatagus* DESOR, 1858

Type-species: *Spatangus hoffmanni* GOLDFUSS, 1829; by original designation (DESOR, 1858: 416).

[*nomen correctum* pro *Spatangus hofmanni* GOLDFUSS, 1829 – GRATELOUP (1836: 175) (presumably intentionally) changed the name to *S. hoffmanni*. According to the ICZN rules this is an unjustified emendation. However, as the name *S. hoffmanni* is in prevailing usage since 1836 and is attributed to the original author and date of the original spelling (e.g. DES MOULINS, 1837: 244; AGASSIZ & DESOR, 1847b: 7; ....), it has to be deemed to be a justified emendation according to the ICZN (4<sup>th</sup> ed., 2000, Article 33.2.3.1.)]

Emended diagnosis: Test cordiform, with distinct frontal notch and transversely truncated posterior end; in profile test high arched to low and slightly wedge-shaped; posterior face low, obliquely to near-vertically truncated; apical disc ethmolytic with four gonopores, madreporite extending beyond posterior oculars; ambulacrum III nonpetaloid, flush with test adapically, increasingly sunken towards the ambitus, with oblique partitioned isopores; paired ambulacra petaloid; petals widening adapically, with large elongate isopores; rudimentary pores in the adapical poriferous zones of the anterior paired petals; adorally ambulacra II and IV strongly constricted near the margin on the oral side in adult specimens; plastron ultramphisterous; labrum elongated, slightly projecting over peristome, with narrow contact to the sternal plates, not extending beyond the 2<sup>nd</sup> ambulacral plates; tubercles confined to posterior half or third on the sternal plates; V-shaped contact between sternal and episternal plates; peristome anteriorly eccentric, kidney-shaped and facing downwards; periproct high in posterior face, usually subcircular or transversely elongated; aboral tuberculation heterogeneous with large, noncrenulate primary tubercles in interambulacra 1 to 4; the tubercles have strongly sunken areoles or are recessed in camellae in some species; no such tubercles in interambulacrum 5 and the posterior part of interambulacral columns 1a and 4b; conspicuous field of coarse tubercles adjacent to adapical ambulacrum III in interambulacral columns 2b and 3a; oral tubercles prominent laterally and arranged in distinct rows, in some species areoles deeply sunken with parapet typically helically spiralled; well developed, bilobed subanal fasciole; up to four ambulacral plates extending into the subanal fasciole (from KROH submitted).

Distribution: Middle Eocene to Miocene – Europe and North America

Remarks: *Lovenia* differs by the presence of an internal fasciole, higher number of ambulacral plates extending into the subanal fasciole (up to eleven, although in some species there are only three or four as in *Hemipatagus*), and less lanceolate petals; in most species of *Lovenia* ambulacral columns Ib and IIa, respectively IVb and Va form a continuous arc (not observed in any known *Hemipatagus* species); in some species of *Hemipatagus* the aboral and/or oral tubercles are not camellate, while this is always the case in *Lovenia*. *Maretia* differs by its extremely shallow frontal notch, the distribution of the aboral primary tubercles (primary tubercle reach the tips of the posterior paired petals), by the lack of strongly sunken areoles or camellate aboral and oral primary tubercles, by the crenulate nature of the aboral primary tubercles, by the lack of a conspicuous field of coarse tubercles in adapical interambulacral columns 2b and 3a, by its oval to shield-shaped subanal fasciole, by the longer primordial plates of the paired interambulacra (plates 1a1, 2a1, 3a1, and 4a1) (extending to the 3<sup>rd</sup> or 4<sup>th</sup> ambulacral plate of the adjacent ambulacra in *Maretia*, while they do not extend beyond the 2<sup>nd</sup> ambulacral plate in *Hemipatagus* or *Lovenia*), by the labrum which extends to the 3<sup>rd</sup> or 4<sup>th</sup>

ambulacral plate (not extending beyond the 2<sup>nd</sup> ambulacral plate in *Hemipatagus* and *Lovenia*) and the less constricted adoral ambulacra 2 and 3.

### *Hemipatagus ocellatus* (DEFRANCE, 1827)

(Fig. 94; Pl. 81, Figs. 1-4; Pl. 82, Figs. 1-2)

- #. 1839 *Spatangus Nicoleti* AG. – AGASSIZ: 33; pl. 4, figs. 7-8
- 1840b *Spatangus ocellatus* DEFR. – AGASSIZ: 2
- 1846 *S.[patangus] ocellatus*, DEFR. – PICTET: 137
- 1847b [*Spatangus*] *ocellatus* DEFR. – AGASSIZ & DESOR: 7
- 1848 *Spatangus ocellatus* (DEFRANCE) – GRAS: 54
- 1852 [*Spatangus*] *ocellatus*, DEFR. – D'ORBIGNY: 139, No. 2631
- non 1855 *Spatangus Hoffmanni*, GOLDFUSS. – WRIGHT: 176-178 [= *Lovenia duncani*, see GREGORY (1891: 624), CHALLIS (1980: 297)]
- 1857 *S.[patangus] ocellatus*, DEFR. – PICTET: 200
- 1858 [*Spatangus*] *ocellatus* DEFR. – DESOR: 422
- non 1864 *Spatangus ocellatus*, DEFRANCE. – WRIGHT: 487-488; pl. 21, figs. 1a-b [= *Lovenia duncani*, see DUNCAN (1889: 265), GREGORY (1891: 624), CHALLIS (1980: 297)]
- ? 1873 *Spatangus ocellatus* ? DEFR. – MANZONI: 10-11, 22
- 1876 *Spatangus ocellatus*, DEFRANCE. – DE LORIOU: 132-134; pl. 23, figs. 2, 2a, 3
- ? 1883 *S.[patangus] ocellatus*, DEFR. – MAZZETTI & PANTANELLI: 65
- 1891 *M.[aretia] ocellata* (*Spatangus ocellatus* DEFRANCE) – COTTEAU et al.: 83 (in the discussion of *Maretia soubellensis*)
- ? 1892 *Spatangus ocellatus*, DEFRANCE. – GOURRET: 130, 142
- 1909 *Hemipatagus ocellatus* DEFRANCE (*Spatangus*), 1827 – LAMBERT: 108-109
- # v. 1912a *Spatangus (Maretia) perornatus* SCHFF. – SCHAFFER: 190-191; pl. 59, fig. 4-6
- ? 1914 *Hemipatagus ocellatus* DEFR. sp. – VADÁSZ: 210-211; fig. 121

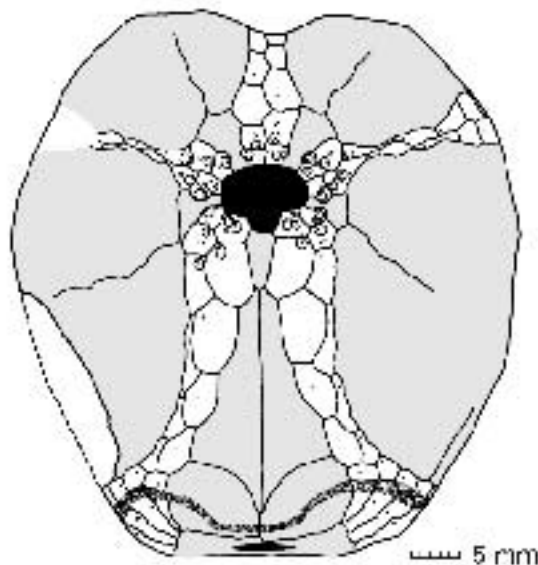


Figure 94: *Hemipatagus ocellatus* (DEFRANCE, 1827): oral plating (Grübern, NÖ, NHMW 1914.VII.22b). Interambulacra shaded.

- 1915a *Hemipatagus Ocellatus* DEFRANCE (*Spatangus*), 1827 – LAMBERT: 189-192; pl. 14, figs. 17-18
- ? 1915 *Hemipatagus ocellatus* DEFR. sp. – VADÁSZ: 237-238; fig. 123
- 1928 *Hemipatagus ocellatus* DEFRANCE (*Spatangus*) – LAMBERT & JEANNET: 176 [II, 94], S.42
- 1951 *Hemipatagus ocellatus* – MORTENSEN: 24; fig. 4d
- v. 1971a *Maretia perornatus* SCHAFFER, 1912 – STEININGER: 596; pl. 1, fig. 5-6
- 1971b *Maretia perornatus* SCHAFFER – STEININGER: 119
- 1971c *Maretia perornatus* SCHAFFER – STEININGER: 129
- 1975 *Spatangus ocellatus* (DEFRANCE) – KOTCHETOFF et al.: 80-86; pl. 8, 3 figs.
- 1984 *Maretia ocellata* (DEFRANCE), 1827 – NEGRETTI: 123; pl. 10, fig. 6
- 1989 *Maretia ocellata* (DEFRANCE) – PHILIPPE: 32, tab. 1
- 1990 *Maretia ocellata* (DEFRANCE, 1827) – PHILIPPE et al.: 247
- 1998 *Maretia ocellata* (DEFRANCE, 1827) – PHILIPPE: 220-223; pl. 22, figs. 6, 7, 8a-b, 9a-b, 10a-c
- v. 1999 *Maretia perornata* – HARZHAUSER & KROH: 221
- v. 1999 *Maretia? perornata* (SCHAFFER, 1912) – KROH & HARZHAUSER: 162-163; pl. 3, fig. 1
- v. 2002 *Maretia? perornata* – LUKENEDER & HARZHAUSER: 462

#### Type-material:

##### *Spatangus ocellatus* DEFRANCE, 1827:

Holotype: unknown, collection unknown  
 Neotype: from the Burdigalian of Taulignan, figured by LAMBERT (1915a: pl. 14, fig. 17); a cast housed in the collection LAMBERT, Muséum national, Paris  
 Locus typicus: Saint-Paul-Trois-Châteaux, France  
 Age: Burdigalian, Early Miocene (PHILIPPE, 1998: 220)

##### *Spatangus nicoleti* AGASSIZ, 1839:

Holotype: specimen figured by AGASSIZ (1839: pl. 4, figs. 7-8), current whereabouts unknown  
 Locus typicus: La Chaux-de-Fonds, Canton Neuchâtel, Switzerland  
 Age: Burdigalian, Early Miocene (PHILIPPE, 1998: 220)

##### *Spatangus (Maretia) perornatus* SCHAFFER, 1912a:

Syntypes: 2 syntypes (KM F/0127, F/0128), figured in SCHAFFER (1912a: pl. 59, figs. 4-6); housed at the Krahuletz-Museum, Eggenburg, Austria  
 Locus typicus: Eggenburg (Kremserberg), NÖ  
 Stratum typicum: Zogelsdorf Fm.  
 Age: Late Eggenburgian (Early Burdigalian), Early Miocene

#### Material:

Early Eggenburgian (Early Burdigalian) – Gösing (Fels Fm.), NÖ, Austria

NHMW: 2 specimens (NHMW 1998z0048/0063, 1998z0048/0067) and 17 fragments (NHMW 2002z0160/0001)

KM: 4 specimens (without inventory no.)

IPUW: 2 specimens (no inventory no.)

Late Eggenburgian (Early Burdigalian) – Eggenburg (Kremserberg, Zogelsdorf Fm.), NÖ, Austria

KM: 2 specimens [KM F/0127, F/0128 (syntypes of *S. perornatus* SCHAFFER, 1912a)]

Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), NÖ, Austria

NHMW: 4 specimens (NHMW 1914.VII.22a-c, NHMW 2002z0159/0001)

Late Eggenburgian (Early Burdigalian) – Unternalb (Retz Fm.), NÖ, Austria

NHMW: 1 specimen (NHMW 1999z0049/0003)

#### Dimensions (in mm):

Inv. No.	TL	TW	TH
NHMW 1997z0049/0003	97.6	89.0	~23
NHMW 1914.VII.22a	63.4	~62 *	15.2
NHMW 1914.VII.22b	57.8	53.8	16.4
NHMW 1914.VII.22c	>55	55.8	-
NHMW 2002z0159/0001	-	54.6	16.3
NHMW 1998z0048/0067	46.2	43.2	~12.5
KM F/0127	72.3	66.9	21.4
KM F/0128	66.4	56.7	>16
KM spec 1 (Gösing)	24.6	23.2	8.2
KM spec 2 (Gösing)	33.0	29.2	10.1
KM spec 3 (Gösing)	33.6	30.8	10.1
KM spec 4 (Gösing)	~50	~47	17.8

\* calculated value (based on the bilateral symmetry of the animal)

#### Description:

**Size and shape:** Test of medium to large size, ranging from 24 to 100 mm test length in the studied material. The outline of the corona is cordate, slightly elongated antero-posteriorly, with a transversely truncated posterior end. A distinct, moderately deep frontal sinus is present. The maximum width lies slightly anterior of the apical disc. In profile the test is low and slightly wedge-shaped with a vertically truncated to slightly overhanging posterior end. The maximum height lies about halfway between the apical disc and the posterior end.

**Apical disc:** The apical disc lies slightly anterior of the centre, about 43 to 45 % TL from the anterior test margin. It is ethmolytic with 4 circular gonopores, the anterior pair of which is slightly smaller and more closely spaced. The madreporite is rather large and elongated posteriorly, extending beyond the posterior ocular plates.

**Ambulacra:** Paired ambulacra petaloid, the anterior paired petals are straight, closed and extend about two-thirds of the corresponding test radius. The posterior paired ambulacra are flexed sharply posteriorly and their distal tips are flexed slightly laterally. Within the paired petals rather large, conjugate, elongate isopores lying in deep, steep-walled depressions are present. The adapical pores, however, are very small, rudimentary conjugated isopores. In the anterior poriferous zones of the anterior paired petals, the ambulacral pores reach their "normal" size from the 11<sup>th</sup> pore pair on, in the posterior poriferous zone and those of the posterior paired petals only the uppermost three to five pore pairs are reduced in size. Interporiferous zone up to twice as wide as a single poriferous zone at its widest point.

Adapically ambulacrum III is flush with the interambulacra, towards the ambitus it is increasingly depressed and forms a distinct, moderately deep frontal notch. It is nonpetaloid and the pores are distinctly different from those of the paired petals. They are minute, strongly oblique partitioned iso- to anisopores.

Outside the petals only minute microunipores are found in the ambulacra, except in the phyllodes and within the subanal fasciole, where 3 enlarged hourglass-shaped unipores are present in each ambulacrum. The phyllodes are not depressed and consist of six large unipores with wide periporal area (except in ambulacrum III, where only five pores are present).

Only secondary and miliary tubercles are present in the ambulacra. On the oral side ambulacra I and V form moderately broad, naked peri-plastral areas. Ambulacra II and IV are extremely narrow between the phyllodes and the margin on the oral side of the test (Fig. 94).

**Interambulacra:** Interambulacra not or only slightly inflated between the petals. Interambulacra 1, 2, 3 and 4 bear very large, perforate, noncrenulate primary tubercles, which are recessed in camellae on the apical surface of the test. The number and position of these enlarged primary tubercles shows considerable variation. Usually they are crowded in the parts